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Abstract

We examine whether an equality of organic standards (EqualOrganic) information treatment impacts Taiwanese consumers' food preference and purchasing behavior. EqualOrganic implies that regardless of products' country-of-origin (COO), organic certifications are based on the same production regulation and managerial processes. We apply discrete choice experiments combined with a propensity score matching approach that ensures structural sample balance between EqualOrganic-treated and non-treated consumers. The analysis is based on fresh sweet pepper purchase decisions of 800 Taiwanese consumers. Results indicate that participants' product choice was sensitive to EqualOrganic information treatment, though different than expected. Information on the equality of organic standards significantly further increased the purchase likelihood for Taiwan-origin organic products, while the opposite effect is detected for Chinese organic products. In addition, we observe an increase in the utility of the opt-out option in the information treatment group. Provision of information thus failed to assure consumers about the equality of organic standards. Instead there is some indication that it eased accessibility of pre-existing doubts about the reliability and trustworthiness of products originating from China. We discuss these findings from a policy and marketing perspective.

Keywords: choice experiment, information treatment, hierarchical Bayesian mixed logit model, propensity score matching

1. Introduction

During their daily food purchases consumers assess the safety and quality of products based on characteristics that are extrinsically visible and those that cannot be easily observed (Moser *et al.*, 2011; Fernqvist and Ekelund, 2013). Among the latter are experience attributes such as taste as well as credence attributes such as the origin of the product and the production method. These credence characteristics are usually presented through labels, which have been shown to influence consumers' perceptions and preferences and thus purchase decisions (Janssen and Hamm, 2012; Loureiro and Umberger, 2007). Many Taiwanese retailers for instance have recently started to display chemical residue test information, particularly for fresh agri-products. This development is the response to numerous food safety incidences. High, and in parts improper, use of chemical inputs in Taiwanese intensive agriculture (Lin, 2002; Yang, 2013) has led to illegal levels of chemical residues in food products with considerable danger for the immediate and long term health of consumers (Epstein, 2014)¹. Those food hazard incidences received high media scrutiny in Taiwan putting public pressure on the food supply chain (Chen, 2007). With the provision of chemical residue test information retailers aim to improve their reputation and protect their retail brand, thereby increasing credibility and trust for consumers. Moreover, the Taiwanese government adopted new food quality and safety standards over the last decade to secure a higher level of transparency for consumers and ease consumption decisions according to consumers' preferences. As one outcome, information with regard to country of origin (COO) information² has become mandatory for all products sold in Taiwan. In addition, in

¹ For example, Fang *et al.* (2016), as well as Liu *et al.* (2012) report an excess of the maximum residue limits set by the Ministry of Health and Welfare for herbs, spices, peas and beans caused by a misuse of pesticides in Taiwan. Chu (2006) examining 12 leafy vegetables detect 19 types of pesticide residues out of which five were considered potentially carcinogenic.

² In 2006 Taiwan passed an act mandating COO labeling on all packaged food which was implemented in 2008. In January 2010, the law for mandatory COO labeling was extended to bulk food products.

2009 a regulatory regime governing the certification of organic foods became obligatory requiring that all agricultural and food products that are labeled as organic and sold on the Taiwanese market have to be certified based on a set of predefined certification standards. This implies that only organic products originating from countries which fulfill Taiwanese organic production regulations can be sold in Taiwan. Thus, for organic products on the Taiwanese market equality of organic standards (EqualOrganic) applies. Given the increasing relevance of organic imported products on the Taiwanese market (Executive Yuan of R.O.C., 2017b) the question arises (1) whether consumers consider this equivalency rule in their purchase decision, and (2) what impact the provision of information on equal standard of organic products has on consumers' product choice.

With the exception of the study by Xie *et al.* (2015) previous research within the area of information treatment has not yet investigated the impact of information on the equivalence of label standards for product or process characteristics of different countries on consumers' preferences and purchase decisions. The present study contributes to the literature in that we apply equal standard information treatment for the attribute level organic from different countries for an emerging country and examine its effects together with a further process standard (chemical residual testing) using discrete choice experiments. In addition, to reduce imbalances in the empirical distribution of the pre-treatment confounders between the treated and control groups when estimating the EqualOrganic information treatment effect, we employ a sample matching procedure based on propensity scores (Stuart, 2010). Though propensity score matching is a popular method in the medical science literature (e.g. Austin, 2008; Islam, 2011; Shiferaw *et al.*, 2014; Rojo-Gimeno *et al.*, 2016) it has to the best of our knowledge so far not been used in studies investigating the impact of information treatment on consumers' (food) preferences.

We use fresh unpacked sweet pepper as the object of study, because it is part of Taiwanese daily diet and available in conventional and organic quality from domestic producers as well as from third countries including two of Taiwan's most important trading partners, China and Japan. Moreover, as a non-branded agri-product, fresh unpacked sweet pepper is especially well suited to investigate the impact of labels related to credence attributes on consumers' food choices (Ubilava *et al.* 2011).

The paper proceeds by first summarizing results of previous studies on consumers' perception for those process attributes of relevance in our empirical analysis as well as on consumers' reaction to information treatment. Section 3 provides an overview with respect to the choice experiment model and design as well as the propensity score matching approach applied. Results are presented in section 4 and discussed in section 5 while we derive main conclusions of our research in section 6.

2. Previous research on consumers' perception of process attributes and the relevance of information in the food market

2.1 Consumers' perception of selected process attributes

Numerous studies have examined the impact of food labels on food purchase decisions providing ample evidence that consumers perceive organic certified products as safer, healthier, better tasting, and more environmental friendly than conventional alternatives (e.g. Paul and Rana, 2012; Zanolini *et al.*, 2012; Van Loo *et al.*, 2013; Schleenbecker and Hamm, 2013). In addition, previous research has investigated region or COO as a determinant for product selection. For example, Lagerkvist *et al.* (2014) show that consumers strongly prefer beef with labels providing information on specific COO compared to beef with labels on EU/non-EU origin. Pouta *et al.*

(2010) found that consumers have stronger positive perceptions for domestically produced broiler meat than for foreign alternatives. In accordance, Pozo *et al.* (2009) arrived at the conclusion that consumers prefer locally grown fruits and vegetables over foreign produce. Comparing consumers' Willingness to Pay (WTP) for origin labels (which indicate domestic or local production) with organic labels James *et al.* (2009), Costanigro *et al.* (2011), and De-Magistris and Gracia (2014) reported higher values for the former compared to the latter while Yue and Tong (2009) were unable to detect significant differences in consumers' WTP between labels related to production origins and production methods. With respect to chemical residue test information Yeh and Hartmann (2016) show that it is perceived as more important than organic labeling but less relevant than COO labeling.

Although there exist a vast literature analyzing consumer preferences for COO on the one hand and for organic production method on the other hand, research on the impact of COO for organic products is scarce (Thøgersen *et al.*, 2017). More specifically, only few studies have as yet analyzed interaction effects between production method and COO labeling. Gracia *et al.* (2014) focused on the interaction between COO and organic labels and do not provide evidence that the two complement each other or not. Costanigro *et al.* (2014) found that provision of local and organic labels leads to a polarization with respect to conventional products, rather than increasing consumer preferences for local and/or organic alternatives. Onozaka and McFadden (2011) conclude that organic labeling mitigates the negative valuation consumers attach to imported apples and tomatoes. Xie *et al.* (2015) and Yeh and Hartmann (2016) confirm this result for some origins but not for all. Thus, though organic labels imply that products have been produced under the same organic regulations consumers' perception of organic products from different origins can substantially deviate. This might be due to a lack of knowledge of the equivalence of

organic standards from different COOs. Thus, respective information might be able to reduce existing biases which will be tested in the empirical part of the paper.

2.2 Impact of information on food attributes

There is already an extensive food related literature investigating the impact of information treatment on consumers' perception of product characteristics (e.g. Fox *et al.*, 2002; Scholderer and Frewer, 2003; Lusk *et al.*, 2004; Annett *et al.*, 2008; Chowdhury *et al.* 2011; Colson *et al.* 2011; Hellyer *et al.* 2012; Vecchio *et al.*, 2016). Many of those studies investigate how information provision impacts the acceptance of new technologies such as irradiation or genetic modification.

Fox *et al.* (2002) showed based on the example of irradiated pork that consumers' demand is more sensitive to unfavorable compared to favorable product information. Annett *et al.* (2008) found that health-related information only combined with sensory evaluation increases hedonic liking ratings of organic food while no effect was detected with respect to environmental information. Chowdhury *et al.* (2011) assessed whether information on the nutritional value of a biofortified staple product influences consumers' WTP. Participants had tasted all products prior to the provision of the information and the choice experiment. According to their results nutrition information increases consumers' WTP for the biofortified variety. Vecchio *et al.* (2016) investigated consumers' WTP for yogurts in two different information treatment settings and found that additional information through a health claim increases consumers' perceived value of functional yogurt compared to its organic counterpart. Hellyer *et al.* (2012) analyzed the impact of health and nutrition information on food choice in an experimental auction setting and revealed a positive reaction to information on consumers' WTP. Colson *et al.* (2011) applied as well an auction mechanism examining consumers' preference for nutritionally enhanced foods

using information treatment. They found that consumers are willing to pay a premium for genetically modified (GM) products for which nutritional information treatment is provided. Also, the study of Lusk *et al.* (2004) focused on GM food using experimental auctions. The authors showed that information on environmental-, health-, and welfare benefits of GM food significantly influences the bid level for GM cookies though not in all countries in the expected direction. The latter effect, the so called communication paradox, was previously identified by Frewer (2003) who demonstrated that information on the benefits of GM food decreased consumers' preferences for those products. Xie *et al.* (2015) is the only study investigating the impact of equality of standard information treatment on US consumers' preferences for organic products from different COO. The authors conclude that the effect of the information treatment on consumers' willingness to pay for imported organic products is heterogeneous with overall relative small effects.

3. Method

3.1 Discrete choice model

In this study, a choice modelling approach was used to uncover consumers' food preferences for product and process attributes with and without information. Discrete choice experiments have been effectively used in marketing and consumer research (e.g. Chen *et al.* 2013; Janssen and Hamm, 2012; De-Magistris and Gracia, 2014). The analysis in choice experiments is based on random utility theory (RUT) (Thurstone, 1927; McFadden, 1974) and Lancaster's consumer theory (Lancaster, 1966). It is assumed that the expected total utility a consumer derives from a good is the sum of the (part-worths) utilities of each attribute that characterizes the good as well as a random error term. Thus, the utility U provided to individual n ($n = 1, \dots, N$) from choosing

alternative j ($j = 1, \dots, J$) with attribute levels k ($k = 1, \dots, K$) of choice task s ($s = 1, \dots, S$) is the sum of a systematic observed component ($\beta_{nk} \mathbf{x}'_{nkjs}$) and a random error term (ε_{nkjs}):

$$U_{njs} = \beta_{nk} \mathbf{x}'_{nkjs} + \varepsilon_{nkjs} \quad (1)$$

β_{nk} is a vector of individual-specific parameters, which represent the partworth utility values for individual n related to the main effects of the alternative's attribute levels reflected by vector $\mathbf{x}'_{nkjs}$. The error term of (1) is assumed to be attribute-specific, independent and identically distributed (*i.i.d.*) (Train, 2009). Traditionally, choice data are analyzed using a multinomial model or the mixed logit model with classical maximum likelihood estimation. Train (2009) shows that the mixed logit model has specific advantages over the multinomial model in terms of flexibility. Compared to the multinomial model, the mixed logit model relaxes both the assumption that the unobserved stochastic portion in the multinomial model is distributed according to a Type I extreme value distribution as well as the assumption of the independence of irrelevant alternatives (Luce, 1959). The core property of the mixed logit model is that instead of assuming fixed partworth parameters, it allows a greater variability of preferences for choice specific attributes based on the distribution function over individuals in the sample (Train, 2009). Thus, the mixed logit model takes into account the heterogeneity in consumer preferences and allows for variation in the attribute values across the sample of consumers (Train, 2009). However, even the mixed logit model with classical maximum likelihood estimation can lead to unreliable estimates when the heterogeneity of the investigated population increases. Therefore, to increase estimation accuracy we apply the hierarchical Bayesian estimation of the mixed logit model (Akinc and Vandebroek, 2017).

The multinomial model is the first step of the hierarchical Bayesian estimation of the mixed logit model that we apply to analyze the choice experiment data. In the second step based on an iterative process the hierarchical Bayesian approach considers the joint distribution of the individual-level parameters (Allenby and Rossi, 1998; Rossi *et al.*, 2005; Train, 2009; Hole 2013)³.

3.2 Discrete choice experimental design and instruments

We apply discrete choice experiments to fresh unpacked sweet pepper as our study object. The following attributes and attribute levels of sweet pepper were derived from focus group discussions⁴ and identified as most important (cf. Table 1): (i) *Country-of-origin* (COO) with the attribute levels, Taiwan, China and Japan, (ii) *Production method* differentiating between the two levels organic and conventional, (iii) *Chemical residue testing* which comprises three levels: respective testing approved in the production country, approved in Taiwan, and no chemical residue test information and (iv) *Price* with the levels 65 NT⁵, 85 NT, 105 NT, and 125 NT.⁶

[Table 1 is placed here]

Figure 1 provides examples on how COO, chemical residue test information and organic labeling is displayed to consumers in Taiwanese supermarkets.

[Figure 1 is placed here]

³ The joint distribution of the individual-level parameters is based on an iterative process where all parameters are randomly selected around a multivariate normal distribution.

⁴ The focus group discussion were held via video meetings with Taiwanese food market experts in March, 2014.

⁵ New Taiwanese dollars. In July 2014, 1 US Dollar=29.98 NT.

⁶ At the time of the survey the price range for sweet pepper on Taiwan's market was between 65 to 125 NT per Taiwanese catty.

An efficient unlabeled choice design was identified using Ngene version 1.1 (ChoiceMetrics, 2012) based on parameter estimates obtained from a pilot study⁷. Our final efficient choice design has a D-error value of 0.237⁸ which is lower than the D-errors of other design alternatives such as the sequential orthogonal design (0.420) and the least efficient simultaneous orthogonal design (2.018)⁹ (ChoiceMetrics, 2012). In addition, the efficient design ensures a sufficiently high occurrence of two-way combinations of attribute levels (see Appendix 1). Therefore, it also confirms the capability of analyzing the interaction effects in the model. The final design consists of 36 choice sets allocated in 6 blocks, with each block consisting of 6 choice situations.¹⁰

The discrete choice experiment questionnaire was formulated in Mandarin and comprised of three sections. In the first section, respondents were screened based on two filtering questions. According to these questions, only participants who are partly or mainly responsible for their household's food shopping and who consume sweet peppers on a regular basis were asked to respond to the remaining part of the survey. In the second section information regarding participants' preferences were requested based on the choice experiment. Our main interest was in assessing the impact of information on the EqualOrganic, that is information on the obligation that all agricultural and food products that are labeled as organic and sold on the Taiwanese market have to fulfill Taiwanese organic production regulations. Accordingly, the following information was displayed to our treatment group in written form prior to the choice experiment:

⁷ In April 2014, we collected piloting data from a convenience sample using an internet-based choice experiment questionnaire in Taiwan. The results were used as the prior information to construct the main experimental design as follows: 1) As prior information the pilot study's parameter estimates were used to derive the asymptotic variance-covariance matrix and subsequently the D-efficient design, 2) Based on an iterative process, the most efficient design with the smallest D-error was derived. Moreover, the pre-testing of our choice experiment questionnaire revealed the feasibility of the experiment, and provided an overview of the initial discrete choice experiment results.

⁸ The D-error is the most common criterion for evaluating the efficiency of experimental choice designs (Zwerina *et al.*, 1996).

⁹ The orthogonality of the sequential orthogonal design only holds within each alternative; in a simultaneous design orthogonality holds across alternatives.

¹⁰ The questionnaire with all choice sets is available upon request.

“No matter where an organic product sold in Taiwan has been produced, the same regulation and managerial processes apply. A product that is labeled organic and sold in Taiwan has to fulfill the Taiwanese organic production regulations and it is ensured that there are no exceptions.”¹¹

Subsequently, the choice experiment started with a standardized introduction of the choice task, including a brief overview of the grocery shopping situation and a reminder to take into account the household's real budget when making the purchase decision. This introduction was identical for the treatment and control group. In order to make the choice experiment as understandable and realistic as possible, the attribute levels were visualized using pictures and text as presented in Figure 2 (translated version). Respondents were sequentially given six choice tasks. Each choice task consisted of three sweet pepper alternatives with varying combinations of products' attribute levels. Participants were requested to make a purchase decision by indicating which of the three alternatives they prefer. We also offered as fourth alternative an “opt-out” option, which ensures that participants are not forced to choose a product they would normally not select. In the third section of the questionnaire, participants were asked to provide information with respect to their purchase behavior, e.g. their shopping frequency, and regarding socio-demographic characteristics such as gender, age and income.

[Figure 2 is placed here]

In July 2014, a group of trained interviewers randomly encountered consumers who stepped out of supermarkets¹² in the three largest Taiwanese cities (Kaohsiung city, Taichung city, New

¹¹ The English translation of the treatment is the one closest to what is originally presented to the Taiwanese consumers in Mandarin.

¹² The two hyper-supermarkets Carrefour (<http://www.carrefour.com.tw/>) and Taisuco (<http://www.tsctaisuco.com.tw/>) were selected based on the convenience of the location, the customer flow and the amount of their fresh agri-food product categories.

Taipei city)¹³. To reduce possible self-selection bias we trained our interviewers to actively encounter randomly every second person leaving the checkout counter of the supermarkets. This was done to ensure that e.g. not only young or female consumers were approached. The average length of the interview was 15 minutes.¹⁴

The choice experiment survey was implemented as a computer assisted web interview. Instead of implementing a traditional web survey with the known disadvantages such as coverage error¹⁵ (Batinic *et al.*, 2002) and non-response error (Bethlehem and Biffignandi, 2012) we used this mixed approach by combining computer assisted personal interviews with traditional web survey techniques. On a rotating basis the control-group questionnaire and the EqualOrganic-treated group questionnaire were shown to the participants. Most people did the survey at the spot in the supermarket with the provided internet-connected electronic devices. In addition, we provided survey invitation cards with a quick response (QR) code¹⁶ for those shoppers who wanted to do the web survey on their own smartphone device. The vast majority of those people did so on-site under the guidance of the interviewers. There was only a negligible group who took the QR code card to possibly do the survey at home¹⁷.

¹³ New Taipei city is located in the north, and the largest city in Taiwan. Taichung city is located in the central area and the third most populated area in Taiwan. Kaohsiung city is the largest city in the south, and the second largest city in Taiwan.

¹⁴ Most of the composite-style (hyper) supermarkets in Taiwan have their own parking zone/parking floor within the building and there is an area between the parking zone and the supermarket where many in-door food stands or restaurants are located (with air-conditioner provided). Our interviewers encountered participants at the exit of the supermarket while they were on their way to the dining place or the parking lot in the building. Therefore, it was ensured that interviewed participants were still close to the shopping spot within the building and were not directly exposed to the sun during the interview.

¹⁵ Coverage error occurs when targeted participants cannot be accessed by web surveys mode, e.g. persons who have no computer devices or internet accessibility.

¹⁶ QR code is one of the most common two-dimensional barcodes in use nowadays (Gottesman and Baum, 2013; Lin *et al.*, 2012). QR codes can be scanned for access to websites, information and applications.

¹⁷ We do not assume that those answering the survey on their own device later at home answer in a different way than those filling out the survey in front of the supermarket. Nevertheless, we cannot rule this out. Unfortunately, it is not possible to identify those who did the survey later at home. However, as indicated above this group is very small. Thus, we are confident that it has no impact on the overall results.

3.3 Examining the sample structure via propensity score matching

To secure balanced sample structures propensity score matching was applied to match surveyed participants from the EqualOrganic treated group and the control group based on a set of observed baseline characteristics (Rosenbaum and Rubin, 1983; Heckman *et al.*, 1998; Rubin, 1997; Ali and Abdulai, 2010; Oliveira *et al.*, 2017; Urama *et al.*, 2017) using the STATA package *pscore* (Becker and Ichino, 2002). Propensity score matching is based on a logistic regression where the binary dependent variable takes the value of 1 for participants that have received the EqualOrganic information treatment and zero otherwise. We included 13 independent variables that potentially have an impact on the choice experiment outcome as well as on the information treatment (Heckman *et al.*, 1997; Smith and Todd, 2005): gender, age range, living location (i.e. in the north / middle / south of Taiwan), living area (i.e. in a big city/ mid-sized city/ rural area), education, marital status, career, household size, number of children, monthly household net income, monthly household food expenses, the average share of imported food in total household and the choice experiment blocking version¹⁸. The predicted values of this regression serve as the propensity scores which reflect the probability that a participant is grouped into the EqualOrganic treated group based on her/his characteristics. Subsequently, a radius-matching process based on a 0.01 caliper range of propensity scores is applied to pair each participant of the EqualOrganic treated group with one or more participants of the non-treated group. Unmatched participants are excluded from further analysis (Dehejia and Wahba, 2002). An illustration of the survey development and research flow is provided in Figure 3.

[Figure 3 is placed here]

¹⁸ We account for incomplete survey responses by imputing missing values of the 13 covariates using the procedure of multiple imputation (MI) (Rubin, 1987; Allison, 2001).

4. Results

1309 people took part in the survey. Excluding those respondents not responsible for their household's food shopping and/or not consuming sweet pepper resulted in 800 (61.1% of all participants) valid responses of which 469 belong to the control group and 331 to the EqualOrganic information treated group. In the following we first describe the results for the propensity score matching (section 4.1). Subsequently, the findings for the discrete choice model are presented for the EqualOrganic-treated- and control group, both before and after data matching (section 4.2).

4.1 Analyzing differences between the control and EqualOrganic treated group using propensity score matching

78 participants of the control group and 20 participants of the treated group were excluded from the further analysis as they were not paired in the matching process. This resulted in 702 observations of which 391 belong to the control group and 311 to the EqualOrganic-treated group. The goodness of the matching process can be assessed by the balancing property which in the present case is fulfilled at $p < 0.01$.¹⁹ This implies that after the matching process participants in both groups are similar with respect to the 13 included covariates even within quantiles of the propensity score distribution (Cavatassi *et al.*, 2011).

Table 2 presents an overview of the demographic characteristics of the control and EqualOrganic-treated group before and after data matching and reveals that the differences between the groups in terms of most demographical characteristics have been reduced significantly. As expected in both the matched control- and EqualOrganic treated group more than 70% of the participants are

¹⁹ Results of the logistic regression underlying the propensity score matching process are available upon request.

females indicating that in Taiwan the majority of grocery shopping is done by women. In addition, within the two groups, most of the participants are young (less than 49: control group 81.8%; treated group 84.2%), highly educated (university degree or higher: control group 54.9%; treated group 53.0%) and generate relatively high household incomes (monthly net household income is above NT 60,000: control group 55.0%; treated group 49.8%). Although the samples are not representative for Taiwan's population in general they provide an adequate reflection of food shoppers in Taiwanese cities, where younger and higher educated consumers make up the majority of the population (Executive Yuan of R.O.C., 2017a).

[Table 2 is placed here]

4.2 Hierarchical Bayesian mixed logit model results

The hierarchical Bayesian mixed logit model results allow to uncover participants' preference heterogeneity at the individual level and to assess the impact of EqualOrganic information treatment by comparing respondents' utilities between the control and EqualOrganic-treated group.

Table 3 presents average importance scores for the four included attributes separately for the control- and treated group before- and after data matching. The findings for the matched samples reveal that COO labeling is the most important attribute as 53.00% and 54.88% of the utility derived from the purchase decisions is related to this attribute in the control and EqualOrganic treated group, respectively. This is followed by the price (control group 22.02%; treated group 21.11%), chemical residue test information (control group 14.28%; treated group 17.77%) and the labeling of production methods (control group 10.71%; treated group 6.24%).

[Table 3 is placed here]

Moreover, Table 3 reveals that EqualOrganic information treatment has induced a shift in the average percentage importance scores from the attribute production method to the one on chemical residue test information. While the average importance of the former significantly decreased by 4.47 percentage points, the latter significantly increased by 3.49 percentage points. In addition, the results in Table 3 demonstrate that the findings before data matching underestimate the impact of EqualOrganic information treatment regarding the shift in importance between the attributes production method and chemical residue testing.

To provide a more detailed picture of the impact of EqualOrganic information treatment, Table 4 illustrates hierarchical Bayesian mixed logit model results²⁰ of the estimated average utilities related to all main effects as well as selected interaction effects for the pre- and post-matched samples. Positive average utility values imply that the attribute level is increasing in preference relative to the other attribute levels while the opposite holds for negative average utility values.²¹ The constant term in the bottom row represents the average utility of the opt-out option calculated as the mean value of individual specific constants. In the following, we first focus on the results for the matched samples (see right panel of Table 4). The findings regarding the main effects of the COO attribute reveal that participants positively value products from Taiwan and Japan with Taiwanese products providing the highest average relative utility. Products originating from China are associated with a negative relative average utility. EqualOrganic information treatment does not lead to significant shifts in the average utility values of the COO attribute. With respect to production methods the results indicate that participants are willing to pay a price premium for organically produced sweet peppers compared to conventional alternatives. However, the EqualOrganic information treatment leads to a significant decrease in the average relative utility

²⁰ The choice data was effect-coded and therefore displays parameter estimates for each single level per attribute.

²¹ To ensure direct comparability of the utilities of the levels within an attribute without having to use a constant as reference, the average partworths reported in Table 4 are zero-centered.

of the former while the opposite holds for the latter. As regards the chemical residue test attribute, the one approved in Taiwan is utility increasing compared to the other attribute levels. In contrast, chemical residue testing approved in the production country is associated with a small negative relative average utility while no testing leads to a high negative relative average utility. EqualOrganic information treatment significantly increases the relative preference of participants for information on chemical residue testing approved in Taiwan. As expected, the average utility for prices is negative in the control and intervention groups implying that higher prices lead to a lower perceived utility. Moreover, the EqualOrganic information treatment does not induce a significant change in the average utility of the price.

The results in Table 4 so far indicate that EqualOrganic information treatment has induced a significant shift in relative utility in favor of conventional compared to organic as well as in favor of chemical residue testing approved in Taiwan compared to respective testing approved in the production country. Considering the interaction effects between attributes and their respective levels allows to gain a more complete picture.

[Table 4 is placed here]

As the EqualOrganic information refers to the production method and COO and given that we observe significant changes in relative utility for the main effects of production method and chemical residue test information, we focus on the following interaction effects: $COO \times Production\ methods$ and $COO \times Chemical\ residue\ testing$. The results show that EqualOrganic information treatment leads to a significant increase in average utilities related to Taiwanese organic (+7.52) as well as Japanese organic (+3.07) products relative to their conventional equivalents. The opposite holds for organic sweet peppers from China. Here we observe a significant shift in average utilities from organic (-10.59) to conventional products

(+10.59). Thus, for organic products from China the negative shift in utility observed for the main effect ‘organic’ is reinforced. A similar finding can be detected regarding chemical residue test information as the observed shift from respective testing in the production country to the one in Taiwan (main effect) is only confirmed for products with Chinese origin while the opposite holds for Japanese products. Moreover, it can be observed that EqualOrganic information treatment has no impact on the perception of chemical residue test information for products with Taiwanese origin.

Finally, we find that the EqualOrganic information treatment significantly increases the average utility of the opt-out option (change in the constant of +25.26) which implies that consumers in our sample prefer to buy none of the sweet pepper alternatives.

Comparison of the pre- and post-matching results reveals in some cases considerable differences in the magnitude of the changes in average relative utilities caused by the EqualOrganic treatment. Moreover, in some cases, significant effects (Interaction COO and chemical residue test) detected before matching proved not to be significant after matching.

Table 4 also presents the major criteria to determine the model fit of mixed logit models: the null- and restricted log-likelihood, McFadden's pseudo R^2 , the root likelihood (RLH)²² (Sawtooth Software, 2009), Akaike Information Criterion (AIC) (Akaike, 1974), Consistent Akaike information criterion (CAIC) (Bozdogan, 1987), Bayesian Information Criterion (BIC) (Schwarz, 1978).²³ Our model shows a pseudo R^2 of 0.75 for the control group and of 0.76 for the treated

²² RLH is the n^{th} root of the likelihood (where n is the number of choice tasks), which is a geometric mean of the standardized predicted likelihood values associated with the alternatives actually selected by participants (Sawtooth Software, 2009).

²³ It should be noted, however, that the comparison between our four models is not possible due to the different degrees of freedom.

group as well as RLH values of 0.71 and 0.72 which, according to Hensher *et al.* (2005) and Louviere *et al.* (2000), represent a good model fit.

5. Discussion

Based on a sample of Taiwanese consumers living in urban areas this study investigated the impact of an equality of organic standard information treatment on preferences for sweet peppers using a discrete choice experiment framework. We focused, besides the attributes COO and production methods, on chemical residue testing and price given their relevance for Taiwanese consumers in their purchase of sweet peppers. The results reveal that COO is the most important attribute for participants in their purchase of sweet peppers, followed by price, chemical residue testing, and production method. More specifically, sweet peppers originating from Taiwan are most preferred, those from Japan take second place while respective products from China are least favored. Moreover, organically produced products are more desired than conventional ones, and products labeled with Taiwan-authorized chemical residue test information are considered superior to those approved in the respective production country and much superior to products without chemical residue test information. These results are in line with previous studies that show the dominant role COO plays in influencing consumers' product evaluation (Becker *et al.*, 2000; Bernabéu *et al.*, 2008). Becker *et al.* (2000), Schnettler *et al.* (2009) as well as Baker and Ballington (2011) support our findings that COO labeling is of greater importance for consumers' preference formation than price. Similar to Chern and Chang (2012) and Schjøll (2017) consumers in our study have a higher preference for domestically produced products compared to foreign alternatives. In addition, in line with Schjøll (2017) we show that COO seems to be much more important than production method in consumers' food choice.

As indicated above, sweet peppers from China are especially negatively evaluated. This low preference for the China COO attribute level can, however, be mitigated if combined with

information on chemical residue testing approved in Taiwan revealing the joint effect quality cues can have on consumers' product evaluation. The same does not hold if the chemical residue testing is approved in China. Those results can be interpreted as a lack of trust in China's food safety authorities and confirms previous findings from Chern and Chang (2012).

The results also indicate that participants in our study attach a higher importance to chemical residue test information compared to production method. We might conclude that the relevance of the organic label is modified in the presence of chemical residue test information. Given the overlap in the content of those two quality cues with chemical residue test information being more specific might have put this label in the focus of consumers' attention. As organic certification implies the logic of zero chemicals our finding, in addition, reflect that participants do not completely understand or trust organic labels thus, confirming the findings of Yiridoe *et al.* (2005). Based on a literature review the authors conclude that consumers have difficulties in understanding the complexity of organic standards and perceive uncertainty and skepticism about organic labels. Also Chen (2009) and Tung *et al.* (2012) who specifically focus on Taiwanese consumers support these findings. According to both studies Taiwanese consumers perceive the danger of fraud with respect to organic foods and have some doubt that products labeled as organic are indeed always grown without using synthetic fertilizers, pesticides, and chemicals. Thus, given the high level of concern about pesticides in food in Taiwan (Tung *et al.* 2012) chemical residue test information is compared to organic standards easier to understand and potentially used as a more reliable cue for food safety.

Our study indicates that the skepticism regarding organic obviously varies depending on the COO of the product confirming again the interaction effect different quality cues can have on consumers' purchase decision (e.g. Onozaka and McFadden 2011). As Onozaka and McFadden (2011), Schjøll (2017) and Xie *et al.* (2015) we find that consumers differentiate organic claims

further if information on country of origin is provided and vice versa. Participants in our study expressed a high preference for organic sweet pepper from Taiwan and Japan and a very low one for the respective product originating from China. This holds, despite the fact that organic standards of the considered countries are equivalent. This finding indicates that consumers in our study are not aware of the equality of organic standards independent of origin or lack trust in this regulation. Also Janssen and Hamm (2014) show at the example of two organic labels that follow exactly the same standards - the German organic label and the respective EU label - considerable differences in consumers' WTP. In fact, they find skepticism regarding the trustworthiness of the organic inspection system in foreign countries as one explanation for this difference. The provision of information thus might help to overcome the deficiencies inherent in markets for credence goods.

In line with previous research focusing on the effect of information treatment (Carlucci *et al.*, 2009; Napolitano *et al.*, 2010; Stolzenbach *et al.*, 2013; Xie *et al.*, 2015), our results show that consumer's perceptions can be sensitive to information. However, unlike what might have been expected we find that information on the equality of organic standards independent of product's origin induces a significant reduction in the importance of the attribute production method while the opposite holds for the attribute chemical residue testing. In addition, and even more surprising, EqualOrganic information further increases the likelihood to purchase organic sweet pepper from Taiwan.

We might interpret this as the communication paradox previously detected by Scholderer and Frewer (2003). The study reveals that compared to a control group without information consumers obtaining information on the benefits of GM food have a lower preference for those products, a phenomenon that can be explained by psychological theories of information processing. According to the attitude activation effect external cues can make pre-existing

attitudes more accessible (Scholderer and Frewer 2003). In our case this could imply that once primed by information on the equality of organic standards, previous attitude towards organic products from China (respectively Japan and Taiwan) stored in consumers' memory became more accessible.²⁴ Research reveals that Taiwanese consumers are skeptical with respect to the quality and safety of products originating from China (Chern and Chang, 2012). Also the findings from our study support the low preference consumers attach to Chinese sweet peppers. Thus, the information on EqualOrganic does not serve its intended purpose but increases participants' sensitivity and uncertainty regarding organic products originating in China.²⁵ Further analysis is necessary to confirm this interpretation.

What we can, however, safely conclude from our analysis is that there exists a knowledge deficit with respect to the meaning of the different quality cues and their interaction and that EqualOrganic information treatment has not eased the purchase decision for participants in our survey but has increased consumers' skepticism. The latter is reflected by the considerable and significant higher average utility of the opt-out option in the information treatment group.

Several points may be raised to the limitations of the present study. First, we focus in our research on an EqualOrganic information treatment at the example of sweet pepper from three origins. Though we assume that our outcomes are similar for other food products, further investigations should cover other countries of origin and different approaches of information provisions. Second, our sample provides an adequate reflection of food shoppers in Taiwanese cities; however, transferability of our results to Taiwanese consumers in general or other countries is not possible. Third, we assess in the present study only consumers' choice behavior,

²⁴ The theory of confirmatory bias explains that people have a tendency to prevent cognitive dissonance (Frey 1986). To do so information not in accordance to prior beliefs and attitude are neglected or even misinterpreted according to previously held views. In the latter case this new "evidence" is then used as additional support for previously held beliefs (Rabin and Schrag, 1999; LaRiviere *et al.*, 2016).

²⁵ In fact, from our results we see that the same holds with respect to products where the origin of the product is China and the chemical residue testing is approved in China which supports our interpretation.

however, it would be interesting to examine psychological criteria that might affect the impact of the information provided on consumer purchase behavior such as consumers' prior knowledge with respect to EqualOrganic, their understanding and trust in the information provided as well as their attitude and trust with respect to different regions of origin.

6. Conclusion

Motivated by the observation that organic products from different COOs receive a highly different evaluation we use a discrete choice experiment framework to explore the impact of EqualOrganic information treatment on Taiwanese consumers' preferences at the example of sweet pepper. As all organic products sold in Taiwan have to be certified by equivalent standards we assumed that providing respective information leads to a shift in consumer preferences towards organic products in general and specifically for organic products originating from China, an origin not highly valued by Taiwanese consumers. However, EqualOrganic information had not the anticipated effects, but reduced participants' preference for organic sweet pepper especially if originating from China.

The findings of our study can provide important insights for policy makers and stakeholders along the food value chain in Taiwan. Our results suggest that information provision might not have the desired effect but to the contrary may reinforce prior skepticism. Thus, to the extent that a further growth of the organic market is desired in Taiwan, it is not enough that governmental agencies introduce new regulation such as the equality of organic standard regulation but it seems essential to implement effective control authorities, secure a high level of transparency and gain consumers' trust. Challenges remain especially in securing Taiwanese consumers' confidence in food products from countries such as China with a somewhat mixed quality reputation. However,

our findings also indicate – independent from the information treatment – that there is a lack of trust in organic labels in general and/or a lack of knowledge regarding what organic implies as consumers favor products with chemical residue test labels compared to organic despite the fact that the former is part of the latter. Thus, private and public actors should shape consumers' perceptions of the standards behind organic and most importantly raise consumers' knowledge how compliance to organic standards is secured.

Finally, our findings reveal that combining choice experiment with propensity score matching to investigate the impact of information treatment on consumers' choice can be useful to reduce potential selection biases in the choice experiment outcomes caused by differences in individuals' characteristics between information treated and untreated samples.

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